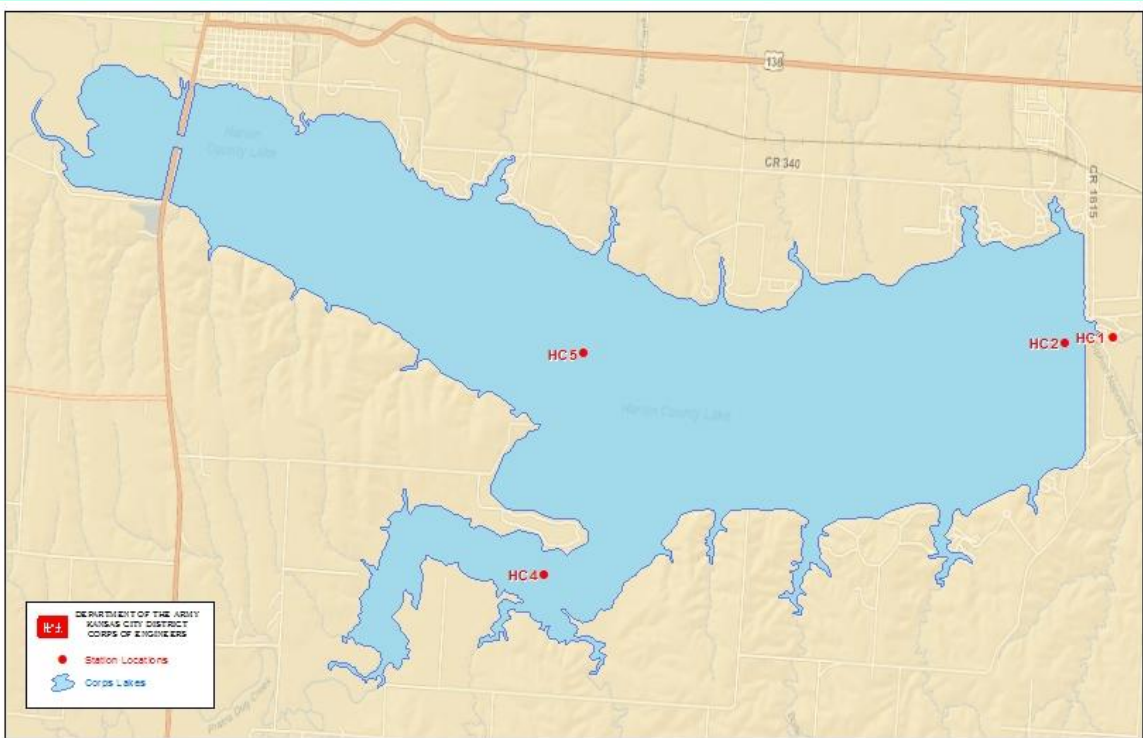


Harlan County Lake Water Quality Data 2003-2012



Harlan County Lake

- Built on Republican River at RM 232 reaching full pool in 1951.
- **Watershed** = 7,169 square miles/ 4,588,160 Surface Acres (SA)
- **Capacity:**
 - Flood Control: 500,000 Acre-feet (AF) / 23,431 SA
 - Multipurpose: 150,000 AF / 13,305 SA / 54 miles of shoreline
 - Avg. annual inflow (2003-2012) = 118,200 AF: 2012 inflow = 75,581 AF
- **Operating project purposes:** flood control, irrigation, recreation, fish and wildlife
- **Water Quality** at Harlan County Lake in 2012 was beneficial to USACE operating purposes listed above, but total phosphorus, total nitrogen and chlorophyll a concentrations exceeded Ne Department of Environmental Quality (DEQ) surface standards for beneficial use of support of aquatic life.

Nutrient Enrichment

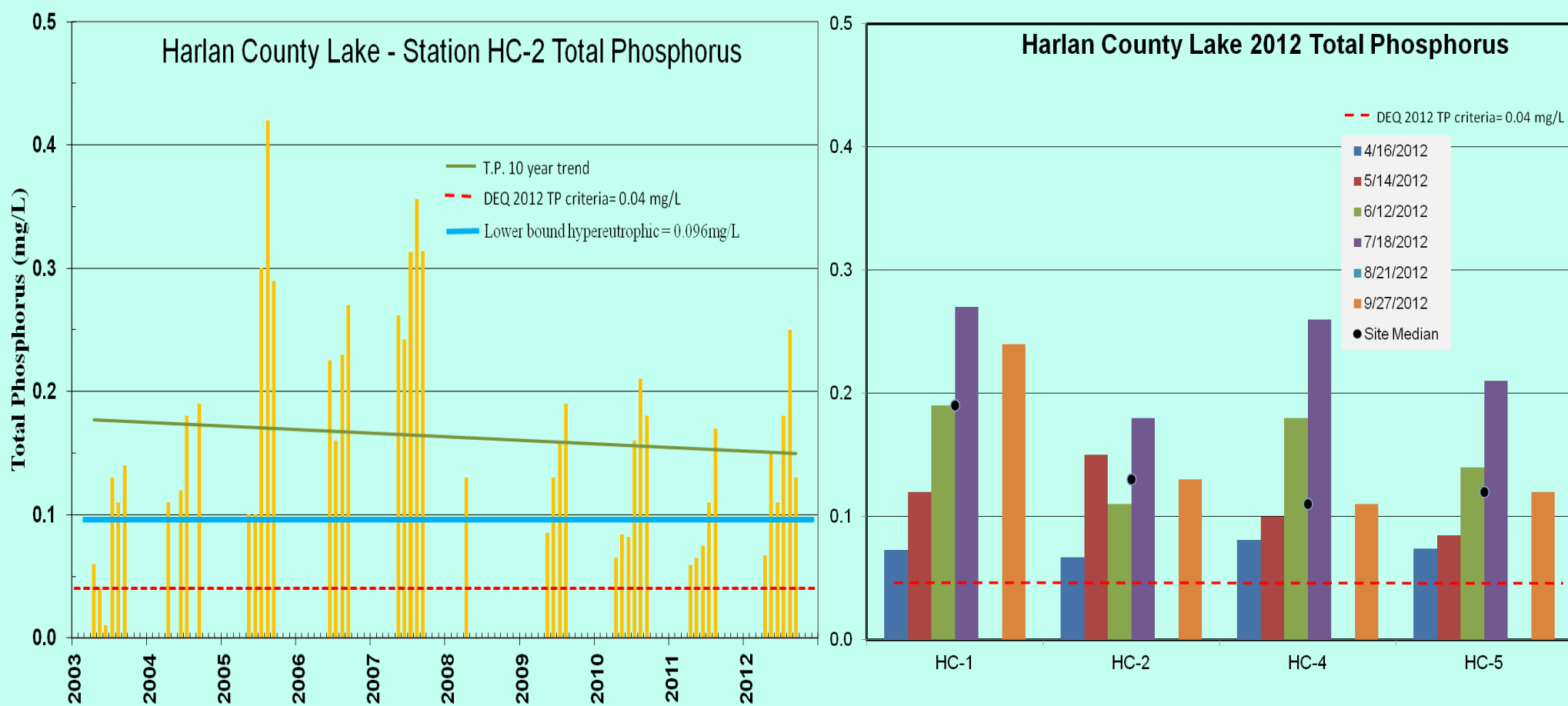
Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and are the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen affecting fish survival, and lead to taste and odor issues in drinking water. Harlan County Lake is listed in the 2012 Nebraska 303(d) list of impaired waters due to excessive total phosphorus and total nitrogen concentrations. Nebraska Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency are working with water quality partners to reduce nutrient inflow into Harlan County Lake in efforts to improve water quality. In 2012, Harlan County Lake ranked above average among District Lakes for average total phosphorus and near average for total nitrogen measured at the site nearest the dam. Total phosphorus mean calculated for 2012 at the dam was 3 times higher than nutrient criteria set by DEQ. Mean TN in 2012 was slightly less than DEQ criteria. Standard error bars in the figures below illustrate the variation in sample results from each lake site in 2012.

The **US Army Corps of Engineers** (USACE) Water Quality Program collects monthly water samples at Harlan County Lake* from April through September. These figures present data collected between 2003-2012 from lake sites (#2,4,5), and the outflow (#1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

*Note: The term “lake” is substituted for technically correct “reservoir” throughout this document for consistency.

Total Phosphorus

Excess phosphorus in Harlan County Lake is a concern and has led to poor water quality including toxic blue green algae blooms in the past. Median total phosphorus concentrations were very high or hypereutrophic range (0.096 mg/L or greater) 2003 to 2012 with the highest levels in 2007 (Median=0.33 mg/L). However, there has been a measurable trend of decreasing TP since 2007. The seasonal average TP exceeded DEQ TP surface water criteria (0.04 mg/L) at all sites and was 3 times higher at HC-2 near the dam. In 2012, total phosphorus concentrations at all lake sites increased in summer months as internal phosphorus was released from bottom sediments from various mechanisms (i.e. wind, common carp, bacteria) impacting water quality and provide increasing amounts of phosphorus to fuel algae production. Late summer phosphorus loading also increases relative abundance of potentially toxic blue green algae species. High levels of TP from inflows and upper lake sites are bound to suspended sediment particles and typically decrease through biological attenuation or consumption by algae and settling as the water moves through the lake to the dam. Low water levels and increased retention time caused physical conditions to maximize internal loading process and maximum phosphorus at the dam rather than upstream sites.

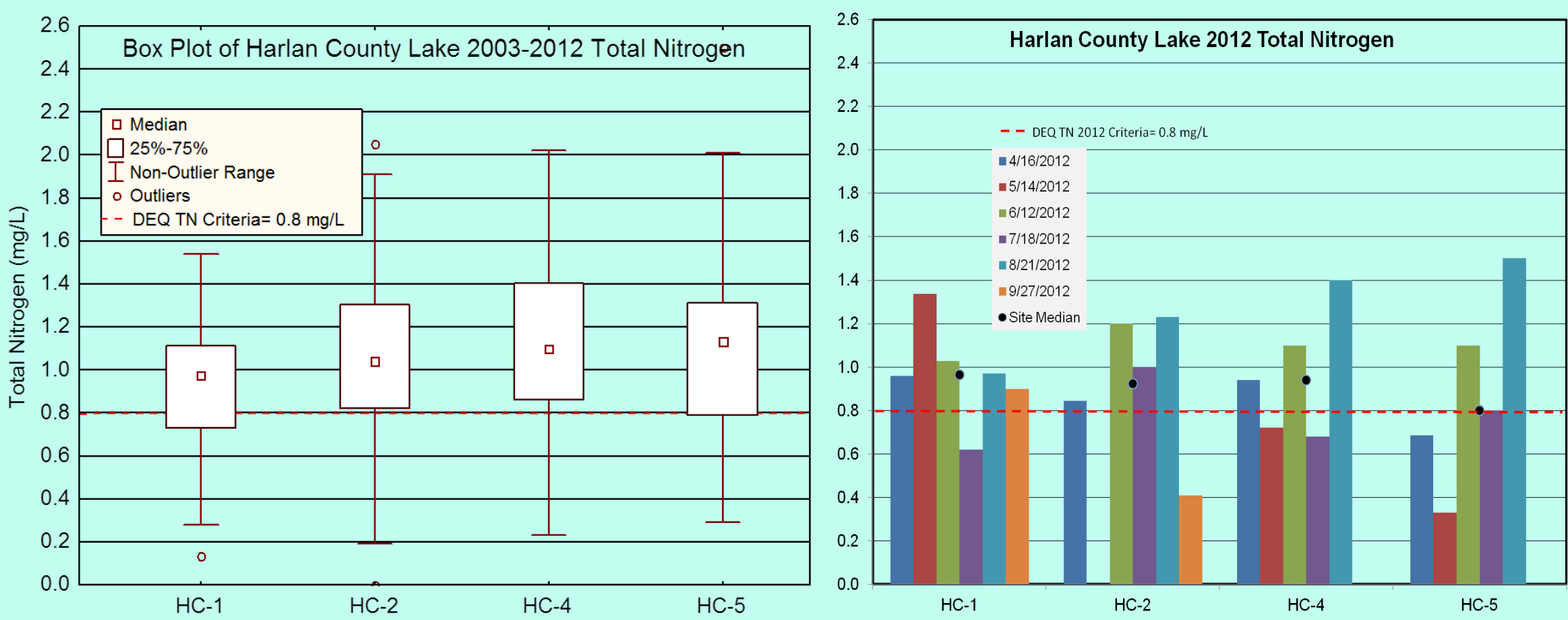


Atrazine

Atrazine is a widely used and frequently detected herbicide throughout the Midwest. Measured concentrations occasionally exceed EPA water quality criteria (3 ug/L) during spring sampling, which coincides with application and runoff. Long-term trends show lake atrazine concentrations are low with two samples exceeding EPA criteria measured from the Republican River site (HC8) from 2003-2012.

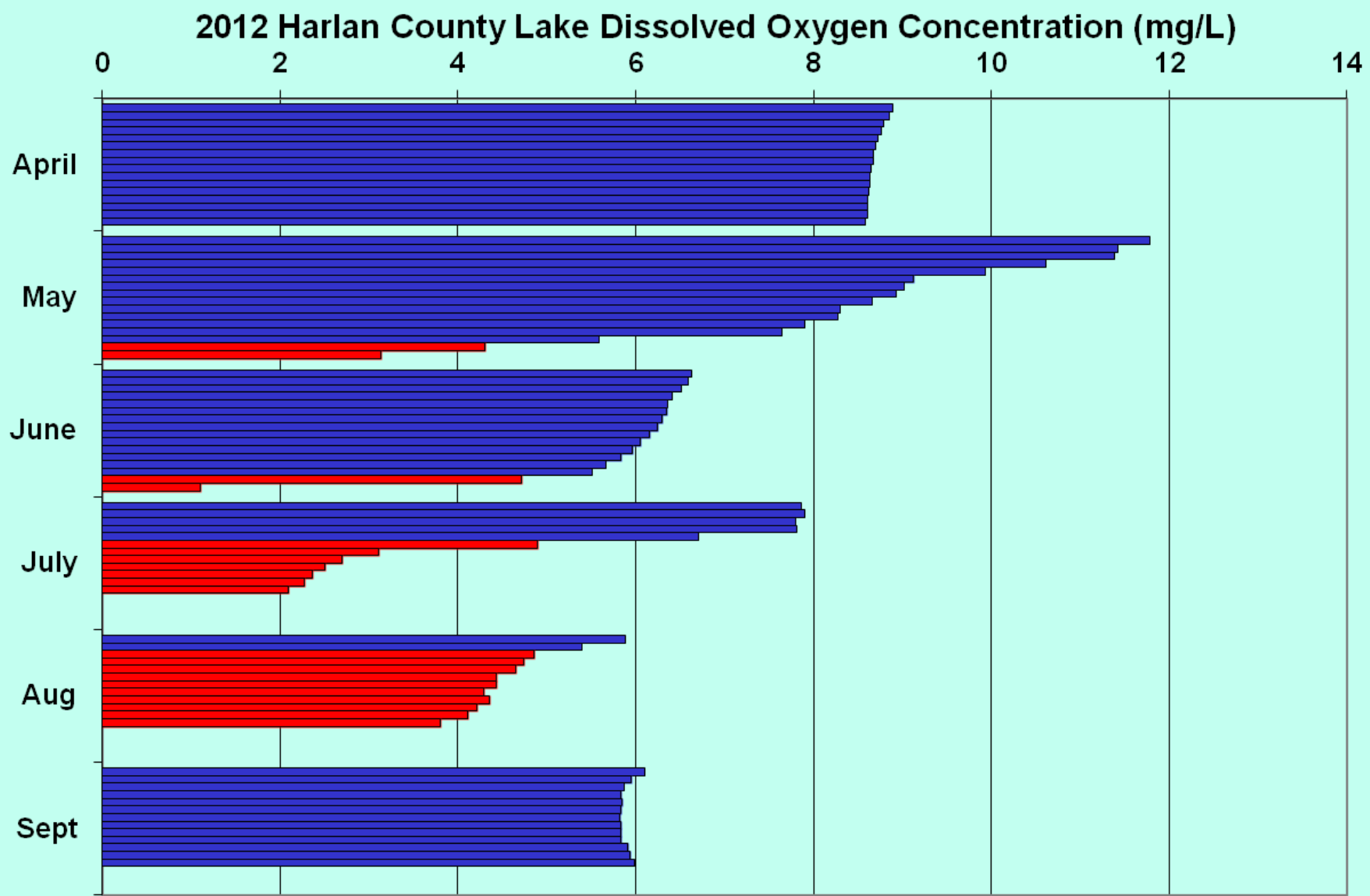
Total Nitrogen

Total nitrogen seasonal average was near DEQ TN surface water criteria (0.8 mg/L) at all sites, but exceeded criteria at HC-4. Monthly TN measurements and 2012 median concentrations were similar to 2003-2012 trends. Total Nitrogen concentrations can be highly variable between sites and years and most related to stream discharge and watershed factors (i.e. soils and farming practices), but 2012 proved to be a stable year with reduced impacts from outside sources.



Dissolved Oxygen

Dissolved oxygen is a factor in aquatic species location, growth, and ultimately survival in lakes. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April through September. Harlan County Lake typically stratifies for a short period of the summer, however adequate (5 mg/L) dissolved oxygen is typically available in the lake. Harlan County Lake was oxygenated in the top 2 meters during the worst conditions in August 2012.



Water Quality Concerns:

- Eutrophication
- Nutrients
- Herbicides



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